19/c

PROGRESS REPORTS

FROM

EXPERIMENT STATIONS

SEASON 1956-57

TANGANYIKA TERRITORY
LAKE PROVINCE

PUBLISHED BY

THE EMPIRE COTTON GROWING CORPORATION
12 CHANTREY HOUSE, ECCLESTON STREET,
LONDON, S.W.1.

1958

COMMONWEALTH MYCOLOGICAL INSTITUTE
20 JUN 1958

PROGRESS REPORTS FROM EXPERIMENT STATIONS

The reports for the seasons up to and including 1950-51 were published in seasonal volumes; the following are still in print and available at 3/- per volume post free.

1923-25 (one volume), 1926-1927, 1931-32, 1934-35, 1935-36, 1942-43 and 1945-46 to 1950-51.

From 1951-52 the reports from each territory were published individually each season. A few of the 1951-52 reports are out of print, but all others are available post free at 1/- per report or 7/6d. for the seasonal set.

TANGANYIKA TERRITORY
LAKE PROVINCE
PROGRESS REPORT FOR THE SEASON 1956-1957

COTTON SEASON.

Planting: Ukiriguru, mid November, 1956, to early January, 1957.
Lubaga, 1st December, 1956, to end of January, 1957.

Picking: Ukiriguru, mid April to late July, 1957.
Lubaga, early May to July, 1957.

Legal Uprooting Date: Ukiriguru and Lubaga, 15th September, 1957.

Rainfall for the period 1st October, 1956, to end June, 1957:
Ukiriguru: 35·30 inches.
Lubaga: 25·92 inches.

INTRODUCTION.

BY

J. E. PEAT.

Ukiriguru Research Centre.

Rainfall.—As last season, the rainfall distribution was very good. At Ukiriguru there was a dry spell in the second half of February, but such dry spells are a frequent feature of the Lake Province climate. There was heavy rain as late as early in June (1·75″), which is unusual.

Staff.—Mr. and Mrs. May visited Ukiriguru early in January; J. E. Peat was on vacation leave from mid March until mid July, and Mr. and Mrs. K. J. Brown proceeded on vacation leave early in October.

M. H. Arnold attended the West African Cotton Research Conference at Samaru, Zaria, Northern Nigeria, from 18th to 23rd November 1957.

V. P. Babla, Assistant Field Officer, was transferred to Tengeru on 18th March 1957. He was succeeded by D. K. Lwehabura, Assistant Agricultural Officer, on 16th February 1957, and by J. B. Machunda on the latter's transfer.

R. A. Brown, Field Officer, continued as Farm Manager throughout the season, and to him and to Shabani Mnuagh, Head Cotton Recorder, as always, much of the smooth running of the station work is due.

After many years of most pleasant association at Ukiriguru, H. Doggett, Botanist, transferred to the East African Agricultural and Forestry Research Organization; and D. L. Jennings, of E.A.A.F.R.O., who was associated with him in his work, has resigned.

Ukiriguru, which has now become the Research Centre for the Western Region of Tanganyika, has been strengthened by the addition of I. A. D. Robertson, Entomologist, for work on cotton pests, more particularly on the biology of American bollworm, and G. M. Dickin, Agricultural Officer, for work on non-cotton regional experiments.

Lake Province Cotton.

For the fourth consecutive season there has been a record Lake Province cotton production, estimated at the time of writing at 150,000 bales. Final adjustments have to await the completion of ginning. The acreage planted was reported as a record. Apart from the Kome Island multiplication of Uk55, the Province was planted to Uk51.

A feature of the year has been considerable delay in picking in some districts, resulting in fair quantities of seed cotton of inferior appearance coming into the market late in the season. In some districts plants were uprooted still carrying cotton.

There have been good yields and high production in the inland growing areas. Cotton around Ukiriguru itself was good—for the level of fertility that exists there. Cotton production in Geita District was less than originally estimated, Ukerewe Island was especially poor, Ukerewe mainland good, and Musoma District patchy. To some extent these responses may have been associated with periods of cloud and heavy rain and with pest damage. The poor Ukerewe Island yields were probably caused by soil exhaustion and nutrient leaching.

There was in general less American bollworm loss than in some years, but marked loss again occurred in areas where there was a cotton/maize association, compared with adjacent areas where the association was bulrush millet/cotton. In the main bulrush millet/sorghum/cotton areas there was very little American bollworm loss. In localised areas in Geita District serious *Helopeltis* damage was reported.

Some testing of insecticide use, based on Ilonga experience, has started. There seems to be no reason why in the areas where the crop potential is high but for pest damage, similar results to those being obtained in the Eastern Province of Tanganyika should not be obtained.

The dressing of Uk51 seed with "Perecot" seems to have kept the primary blackarm phase of *Xanthomonas malvacearum* in hand again, although there was as before an appreciable amount of bacterial bollrot.

Fusarium wilt, which had been reported previously in the Geita District, was found on Kome Island, where Uk55 was under second season multiplication. It was decided not to proceed further with this Uk55 multiplication; a fresh start has been made for the 1957-58 season in a new multiplication area, with Uk55 seed supplied from Ukiriguru.

Summary of the Main Results.

As in previous years, direct and residual responses to dressings of cattle manure and to applications of fertilizer have been very satisfactory, with especially impressive interactions between nitrogen and phosphate.

On the more exhausted hill sands full use of any cattle manure available is recommended, together with applications of phosphate and top dressings of nitrogen where cattle manure is insufficient.

On Ukiriguru the response to tying ridges was not as great as in drier years.

The best cotton yields were from plantings in November/December, with a falling off in yield for cotton planted in January; February plantings gave just about half the yield of the November/December plantings.

In the soil science section, the first task has been a study of the nitrate status in an NPD trial. Information has been obtained on the accumulation and movement of nitrates throughout the season, samples being taken down the profile to 5′ 6″. Moisture determinations have also been made. A very interesting observation is that in a dry period water removal by the crop seems to have occurred mainly from and below the ridges, with little change in soil moisture below 6″ in the furrow.

The "High Field" plot at Ukiriguru, planted with Uk55, well manured, top dressed with nitrogen, and sprayed with insecticide, yielded 2,050 lb. seed cotton per acre.

Strain trial yields from Ukiriguru, Lubaga, and the district plots, supported by the laboratory analyses and spinning test results, endorse the Ukiriguru policy of successive seed-issues, with Uk55 now replacing Uk51. Testing continues of segregates from 0/334 and 1/667, the constituents of Uk55. Instead of constituting Uk57, as was at one time intended, the best segregates are being mutiplied separately on Ukiriguru, mainly in replications of the agronomic trials, for an issue of Uk58 after this further year of testing.

In the best district plot Uk55 yielded over 2,000 lb. seed cotton per acre, and the mean Uk55 yield in seven inland plots was over 1,000 lb. as against 721 lb. for Mz561.

The hybridizing programmes with Albar 51 and BAR 14/38 continue. The stage has now been reached of testing the best segregates from the Albar 51 programme against the straight 0/334 and 1/667 segregates. These two strains possess a reasonable degree of bacterial blight resistance.

On Ukiriguru, American bollworm damage to cotton was local and largely confined to late planted cotton. The Botanist, however, reported a big American bollworm population in January on his early planted sorghum; a further sorghum generation, planted in early February, collected a very heavy American bollworm population in April/May, the period when heavy damage often occurs on cotton.

General Account of the Work for the Season.

Husbandry.

BY

J. E. PEAT and K. J. BROWN.

Time of Planting.

In the Ukiriguru time of planting trial there was no difference in yield between mid November and mid December planting, though in practice mid November is too early, bearing in mind the fact that a fair amount of cotton would be opening towards the end of April and into May, generally a very wet period. Mid January planting fell to around 80% of the November/December yields, and mid February planting to under 50%.

In the district plot observations, yields from January planting were on the whole quite a bit poorer than from December planting. The real drop in yield, however, was from planting in late January and into February.

The general recommendation is that land should be prepared in November, and that as much planting as possible should be accomplished by the end of December.

Delay in weeding means a set-back to plant development.

Land Resting.

In Trial (6) the third cotton crop, following three years' tumbledown fallow, still showed an increase in yield of about 45% compared with the third cotton crop following three crops of millet. Owing to the high error, however, differences were not significant. The trial has been discontinued.

In Trial (41), where yields were low, cotton after a one year clean bare fallow gave a significantly lower yield than the continuously cropped control. Cotton after one season of tumbledown fallow, on the other hand, gave a significantly higher yield than control.

In Trials (36) and (31) the first residual cropping after one season's treatment still showed a suggestion of tumbledown fallow benefit, but in the second residual cropping there were no significant responses.

Manuring and Fertilizers.

This work at Ukiriguru is now approaching the end of a phase. Future work will be in closer association with the soil science section, to try to find the reasons for the results obtained. The NP interactions obtained are already being better understood.

The long continuing responses in these hill sands from dressings of cattle manure have been abundantly proved. The results this past season from applications of phosphate, with later top dressed sulphate

of ammonia or urea, are completely in line with the results of the last few years. There is a strong interaction between phosphate and nitrogen. It would appear that there must be sufficient phosphate available, and possibly other nutrients, for nitrogen dressings to be effective; given that, the responses to top dressed nitrogen are very impressive.

In the area, the use of cattle manure is increasing, but there must always be, under present African conditions, the difficulties of transporting tons of cattle manure to the fields, more particularly as these are ridged. The use of fertilizers has been very disappointingly slow considering the large responses that can be obtained. The labour of transporting fertilizers is a minor matter compared with that of transporting cattle manure. However, apart from anything else, there

TABLE 1.

MANURIAL TRIAL.

Ukiriguru—Hill Sand—Trial (8).

8 blocks of 6 plots, initial treatments applied in November, 1944. Half plots, each 1/35·6 acres, were manured at the same rates in November 1952 and November 1955 or received sulphate of ammonia at 175 lb./acre early in March 1953, 1954, 1955 and 1956. 75 lb. and 150 lb. respectively of double superphosphate were applied in 1956 on the plots initially given 3 tons/acre compost and 3 tons/acre farmyard manure in 1944.

5 foot ridges, 2 rows at 18″ spacing, 2 plants per hole. Cotton planted 10th December, 1956.

Treatments		*Yield of seed cotton in lb./acre*		
		Thirteenth indicator crop	*Second indicator crop—second re-application*	*Yearly applications nitrogen (ash 1944 only)*
		Treatments applied 1944	*Treatments re-applied 1952 & 1955*	*S/ammonia applied 1953, 1954, 1955 & 1956*
Control—no manure		339	—	494
Initially, compost—3 tons/acre—now 75 lb./acre double superphosphate		341	(Compost) 673	—
Initially, farmyard manure — 3 tons/acre — now 150 lb./acre double superphosphate		485	(FYM) 690	—
Compost—7 tons/acre		488	721	—
Farmyard manure—7 tons/acre		542	1073	—
Cotton seed ash—1½ tons/acre		639	—	1080
S.E.	Treatments in same column	± 53	± 90	± 90
Sign. Diff. (P=·05)	Treatments in same column	153	258	258
	Treatments in same line		184	
	Treatments not in same line or column		209	
Coefficient of Variation			32·6%	

are probably problems of finance at the beginning of a planting season; the local cost of 100 lb. of double superphosphate has been Shs. 42/41, and of 100 lb. of sulphate of ammonia Shs. 36/39. Responses from superphosphate continue for at least three seasons; nitrogen has to be top dressed every year, although, as recorded in the soil science section, there is evidence early in the season of some residual nitrogen from the application of the previous season.

Trial (8) has been amplified, but the plots carrying the initial applications (applied in 1944) carried the 13th indicator crop. Results are shown in Table 1. The lower dressings of compost and farmyard manure were considered to have been exhausted, and two dressing rates of double superphosphate were added to the original plots (not, of course, to the re-applied plots). It can be seen that there is still a residual response from the heavier dressings of compost and farmyard manure, and from the heavy dressing of cotton seed ash. The first residual responses from the second manurial re-applications are more or less as would be expected. There is a particularly satisfactory response from the plots which received 7 tons an acre farmyard manure in 1944, 1952 and 1955; an increase of more than 700 lb. seed cotton per acre over the control of 339 lb. There was this season a response

TABLE 2.

NPD EXPERIMENT.

Ukiriguru—Hill Sand—Trial (9).

Started NPK (1947-48).
NPD (1950-51). Re-applied 1956-57, 6 tons/acre compost, 75 lb. and 150 lb. basic slag, and urea 90 lb./acre half at ridging, half top dressed mid February, 1957. First indicator crop, fourth cycle.

2 × 3 × 2 factorial with NPD and ND interaction partially confounded, testing all combinations of:—

n_0, n_1 0, 90 lb. urea/acre, half at ridging, half top-dressed.
d_0, d_1 0, 6 tons compost/acre.
p_0, p_1, p_2 0, 75, 150 lb. basic slag/acre.

6 replications in 12 blocks of 6 plots, each 1/69·7 acres. Compost and phosphate re-applied November, 1956. Cotton planted 21st November, 1956.

Mean yields: seed cotton lb./acre.

	(1)	*n*	*d*	*nd*
(1)	779	998	1466	1803
p_1	907	1285	1437	1856
p_2	1021	1468	1522	1842
S.E.	All comparisons		± 62	
Sign. Diff. (P = ·05)			176	
Coefficient of Variation			17·3%	

Main effects:

	N	P_2	*D*
	+353	+202	+578
S.E.	± 25	± 31	± 25
Sign. Diff. (P = ·05)	72	88	72

to the sulphate of ammonia dressing on the control plots, but the striking response was to the top dressing of sulphate of ammonia on the residual ash plots; this raised to 741 lb. the residual ash response of 300 lb.

The results from Trial (9) are set out in Table 2. The yields are from the first indicator crop of the fourth cycle of the experiment, and therefore the responses must include residual benefits. The heaviest NP applications gave an increase approaching 700 lb., roughly the same as obtained from compost. Urea was used as the nitrogen dressing, and for the first time basic slag as the phosphate dressing. With a control of 779 lb. an acre there was a response from nitrogenous dressing to the control plots. Rates of basic slag applications were low, and it is considered that part of the phosphate responses would lie in residual benefits—compare the phosphate treatment yields with those in the 1955-56 and 1954-55 seasons.

TABLE 3.

NPD EXPERIMENT.

Ukiriguru—Hill Sand—Trial (26).

5 replications of 2 × 2 factorial, with split plots of 1/69·7 acres giving 4 nitrogen treatments. Compost and phosphate applied in 1952 and 1955. Sulphate of ammonia applied at flowering February, 1955, February, 1956, and early March, 1957.

5 foot ridges, 2 rows at 18″ spacing, 2 plants per hole. Cotton planted 17th December, 1956.

p_0, p_1 0, 150 lb. double superphosphate/acre.
d_0, d_1 0, 6 tons compost/acre.
n_0, n_1, n_2, n_3 0, 50, 100, 200 lb. sulphate of ammonia/acre.

Mean yields: seed cotton lb./acre.

Nitrogen treatments (applied each season)	*Second indicator crops from dressings of compost and phosphate.*			
	(1)	*d*	*p*	*pd*
No nitrogen	427	981	574	1048
50 lb./acre	601	1046	875	1042
100 lb./acre	581	1131	890	1294
200 lb./acre	611	1128	1023	1405
S.E. / Sign. Diff. (P = ·05)	Treatments in same column			± 63 / 178
S.E. / Sign. Diff. (P = ·05)	Treatments in different columns			± 64 / 198
Coefficient of Variation				23·4%
Main effects: P + 205	S.E.			+ 60
	Sign. Diff. (P = ·05)			130
D + 437	S.E.			± 32
N_2 + 217	Sign. Diff. (P = ·05)			90

The results from Trial (26) are set out in Table 3. The results are very similar to those in Trial (9). From a control of 427 lb. seed cotton an acre, the top NP yield rises to 1023 lb., roughly the same as

the first residual compost response. Both compost and phosphate responses are first residual. Sulphate of ammonia was re-applied.

Comment has been made in other years that Trial (38), an attempt to assess response curves for nitrogen and phosphate dressings, was on land too rich to show marked responses. The control yielded 1143 lb. seed cotton an acre. The second residual phosphate yields were no better than this, and the highest N response was 200 lb. an acre. This trial has been discontinued.

Ridge Tying.

On Ukiriguru there was no difference, in this season of good rainfall distribution, between cotton grown on tied and not tied ridges; but there was a suggestion of better yields, as a result of tying, where bulrush millet was the crop. These ridge-tying experiments at Ukiriguru are now being discontinued. It is abundantly clear that over the years, more especially with cotton, ridge-tying is very worth while. This is now generally accepted.

At Lubaga, on cemented hard pan soil, "ibambasi", once again both cotton and sorghum gave a considerably better crop from 3′ and 4′ ridges, tied, than from flat cultivation. For cotton the crop was practically doubled.

Soil Science.

BY

P. H. LE MARE and A. M. KABAARA.

Soil Nitrate Studies.

A study was made during the 1956-57 season of the quantities and movements of soil nitrate under a cotton crop in NPD Trial (26). Soil samples were taken at approximately fortnightly intervals from the eight combinations of the following three treatments.

n: Sulphate of ammonia at 200 lb./acre applied on 9th March 1957. A similar application was given to the previous crop in February 1956.

p: Double superphosphate at 150 lb./acre applied to the previous crop in November 1955.

d: Compost at 6 tons/acre applied to the previous crop in November 1955.

The sampling depths on each occasion were 0″-6″, 6″-12″, 24″-30″, 42″-48″, and 60″-66″. Only replicate 3 of the experiment was used.

The final yields for the treatments studied are given in Table 4 for replicate 3 and for the trial as a whole.

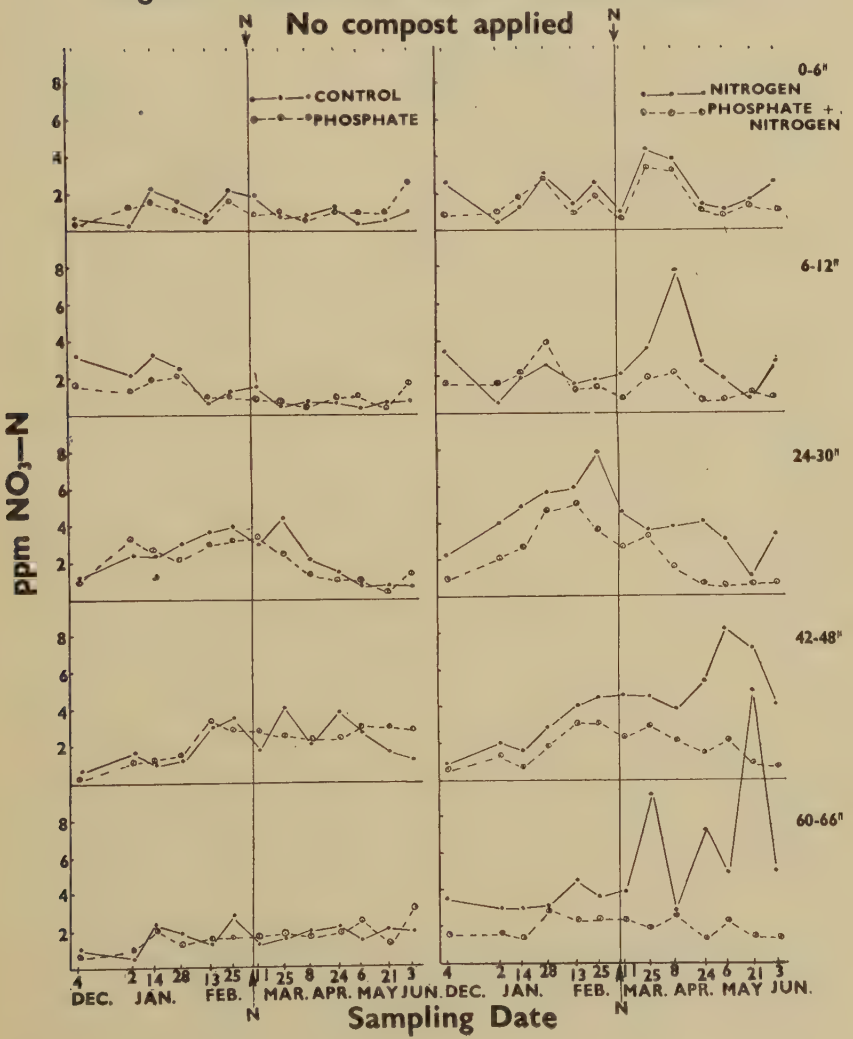
TABLE 4.

Seed cotton lb./acre.

	Replicate 3		*Whole Trial*	
	(1)	*n*	*(1)*	*n*
(1)	487	765	427	611
p	596	1083	574	1023
d	1035	1283	981	1128
pd	1061	1457	1048	1405

The yields in both cases are similar, except that the yield resulting from the use of N alone was rather higher in the replicate 3 than the mean yield given by this treatment in the whole trial.

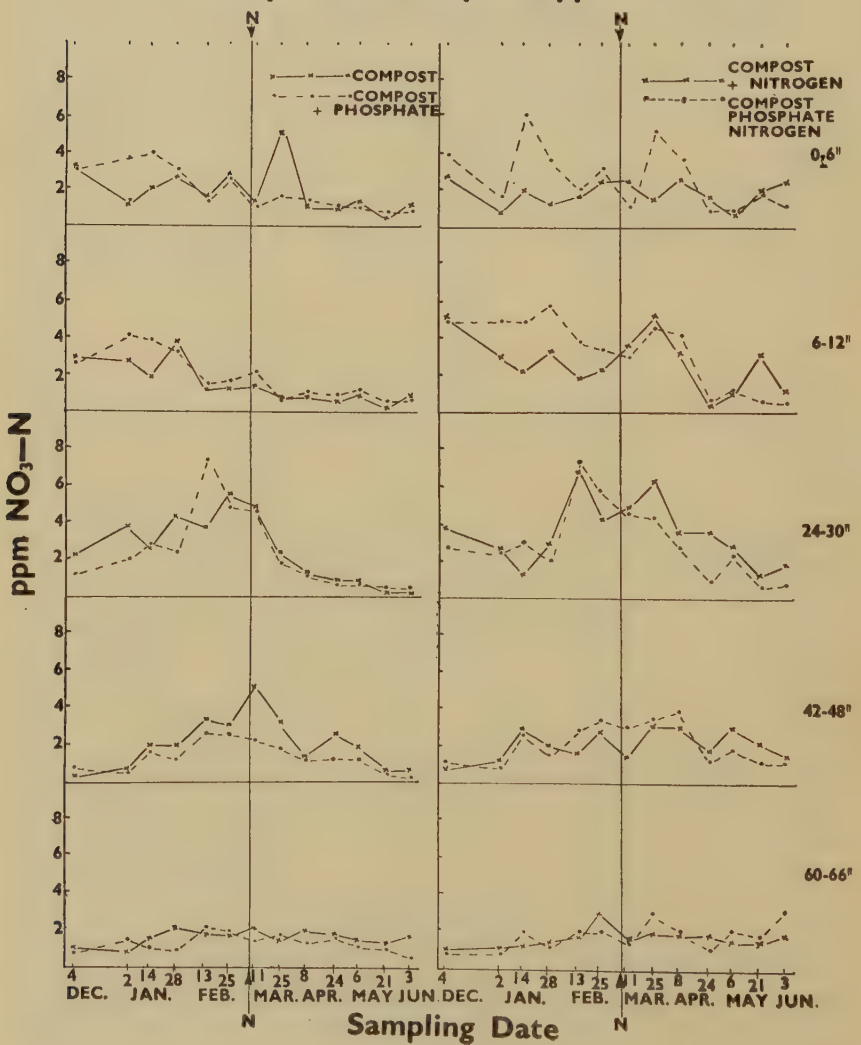
Figure 1. Soil Nitrate under cotton 1956-7



The data for soil NO_3-N throughout the season are given for N and P treatments, in the absence of compost in Figure 1, and in the presence of compost in Figure 2.

(a) *Compost absent* (*Figure 1*).—Where fertilizer nitrogen was not applied, the graphs for treatments with and without P are very similar. There was a small accumulation of nitrate at 24″-30″ and 42″-48″ up to March, but thereafter the value for NO_3-N was very low throughout the soil, being about 1 ppm in the upper layers, and 2 ppm at depth.

Figure 2. Soil Nitrate under cotton 1956-7
6 tons per acre compost applied in 1955



On plots which had received nitrogen there was evidence in February of residual N from the application of the previous season. At 24″-30″ the peak NO_3-N values in the absence and presence of P were 8 ppm and 5 ppm respectively, about twice the amount which occurred on plots which had no N in the preceding year.

About a fortnight after the application of ammonium sulphate in March 1957 there was an increase in NO_3-N at 0-6″ on both P and no P plots, but by the end of April surface nitrate was reduced to 1 ppm. In lower zones the amount of NO_3-N present depended upon whether or not P had been given. On the P plot the NO_3-N value fell in April to about 1 ppm at all levels. In the absence of P there seems to have been an excess of nitrate over the crop uptake as indicated by peaks on the graphs which occur in the successive zones at approximately fortnightly intervals. However, no sharp peak is shown for 24″-30″; the sampling is assumed to have missed this.

The data help to explain the yield results, which indicate that the presence of phosphate is necessary for utilization of added nitrogen in the hill soils at Ukiriguru. The soil nitrate data indicate that, if phosphate is not given, nitrate surplus to crop uptake accumulates in the soil. The data also indicate that the time of application of ammonium sulphate was correct, at a time when the early accumulation of nitrate at about 24″ was being used rapidly by the plants and the soil nitrate was falling in all zones of the soil. On the phosphate plot there was clearly a heavy demand for nitrate in late March since the applied ammonium sulphate was detected in very small amounts only.

(b) *Compost present* (*Figure 2*).—In the absence of added nitrogen, compost appears to have had little effect in increasing the quantity of soil nitrate surplus to the uptake by the crop, the graphs being very similar to those obtained in the absence of compost.

On the plots receiving added nitrogen the status of surplus nitrate in *nd* and *npd* plots was, throughout the season, very similar to that in the *np* plot. Like phosphate, compost appears, from the evidence of soil analysis, to have permitted greater uptake of added nitrogen by the crop, no accumulation being found in the soil. This finding is, however, at variance with the yield data, for the increase due to N on the compost plot without phosphate was similar to the increase due to N on the plot without either compost or phosphate. Luxury consumption may have occurred but as uptake of N by the crop was not determined this can only be considered as a possibility. Chemical analysis of plant samples is planned for the coming season in an attempt to elucidate this problem.

(It will be noted from the trial yields that compost must be providing for uptake by the crop of reasonable quantities of nitrogen—as well as phosphate. Thus the NP_2 responses in Table 2 and Table 3

are roughly equivalent to the compost responses, though a further response is obtained on addition of nitrogen).

The compost was applied in 1955 to the previous cotton crop. At the time of planting the cotton crop discussed in this report (December 1956), soil samples were taken and analyzed for total nitrogen. Only compost influenced total nitrogen; the data for this treatment are given in Table 5.

TABLE 5.

TOTAL N% IN SAMPLES FROM TRIAL (26) DECEMBER, 1956.

	Compost.	
	None.	*6 tons/acre applied in November, 1955.*
0 -6″	0·025	0·030
6″-12″	·023	·025
24″-30″	·020	·022
42″-48″	·021	·020
60″-66″	·015	·017

Compost has increased the total nitrogen of the surface soil. However, since no nitrate accumulation was detected during the season and since the crop responded to added nitrogen in the presence of compost, it seems that the rate of nitrification of the increased total nitrogen was inadequate, particularly where phosphate was given also.

As the compost was applied before the present work was started, no sample of it was obtained. However, compost and other cattle manure made at Ukiriguru is now being sampled and analyzed. An estimate of the quantity of minerals applied can now be made.

Soil and plant analyses are also in hand to investigate the effects of cattle manures and fallows on nutrients other than nitrogen.

Soil Moisture.

In December 1956 nylon electrical resistance units* were placed at 6″, 12″, 24″ and 36″ below the surface of the furrow, the side of the ridge and the top of the ridge. Similar sets were placed in flat cultivated land. Cotton was grown on all sites.

On the ridge and furrow site, soil moisture was apparently adequate during January, the resistances being 3·0-3·5 log ohms, and little change occurred until the dry spell in February. During that month the resistance of all units below the side and top of the ridge rose steadily to 4·0 to 4·5 log ohms. Under the furrow, however, there was little change, except in the units at 6″.

Rain on 5th and 10th March (0·7″ and 1·9″ respectively) caused a general drop in resistance of units below the side and top of the ridge, with the exception of those at 36″ below the top of the ridge, which

*Farbrother, H. G. (1957). "On an electrical resistance technique for the study of soil moisture problems in the field." Part 1, Empire Cotton Growing Review, April 1957, pp. 71-89.

remained at over 4 log ohms until the frequent rains in April. In the latter part of March there was little rain and resistances tended to rise until the rain early in April. Thereafter soil moisture was apparently adequate until mid June when rainfall ceased and thereafter resistances began to rise slowly.

Below the furrow there appears to have been little change in soil moisture, the variation in resistance being confined largely to the units at 6″. Water removal by the crop seems to have occurred mainly from the ridges and the soil below them. Little of the reserve below the furrow seems to have been tapped. This is a most important observation. It is clear that moisture is removed from at least 3 feet below the ridge during a dry period by a cotton crop two to three months old. Further work with resistance units is necessary and the commencement of root studies is highly desirable.

On flat land the moisture status during the February dry spell appeared to be rather lower than under the furrow, but somewhat higher than under the ridge. During the rest of the season resistances indicated that down to three feet there was always water available to the crop.

Cotton Breeding.

BY

J. E. PEAT and K. J. BROWN.

There are three cotton breeding programmes: the initial straight selection and testing of AR Mwanza material, and the two programmes adding resistance to bacterial blight.

Segregates from the initial programme are now being tested in trials against segregates from the Albar 51 hybridising programme. There are a number of factors involved: firstly comparative lint yields over a few seasons and over a scatter of district plots, and secondly a comparison of different cropping habits and lengths of time to maturity against those of the present straight Ukiriguru strains. Then there are lint quality assessments, finishing up with Shirley Institute fibre and spinning test results, and yarn appearance valuations.

A very important contribution to our understanding of the behaviour of some of the straight Ukiriguru material, mentioned in the bacterial blight section, has been the evidence that the 8/290 segregates possess a fair degree of blackarm resistance, and some resistance to bacterial bollrot, the latter being of special importance. Thus in selecting and testing over the years and over the Province, with lint yield and clean boll-opening as two of the main criteria, the presence of resistance to bacterial blight had been exploited before pathological follow-up was possible.

The main Ukiriguru trials (one 49 strain trial, one 25 strain trial, and a duplicated 25 strain trial, all balanced lattice designs), and a similar 25 strain trial at Lubaga, were concerned with testing segregates from the best Ukiriguru material against the parent strains, especially segregates out of the 8/290 lots, 0/334 and 1/667, the constituents of Uk55. Uk51 yields (control) varied from around 1,000 lb. seed cotton per acre to over 1,500 lb. Differences between strains were not as marked as in some of the district plots. There seems to be evidence that variability in the segregates is being exploited. There are lint yield differences, and differences in ginning percentage, lint length, lint index, and amount of seed coat damage; from spinning and fibre tests it would look as though some of these segregates are giving better yarn than Uk55. One of the best segregates in field testing, 55/106, ex 0/334, just about significantly heavier yielding than Uk51 and Uk55, had a yarn appearance grading of $1\frac{1}{2}$ in one trial compared with 3 for Uk55. This is the best yarn appearance grading obtained for Ukiriguru material.

It had been proposed to constitute Uk57 from the best of these segregates for multiplying on Ukiriguru, to replace Uk55; but as there was sufficient seed available they are being bulked separately, mainly in replications of agronomic trials, to allow of a further year of testing before constituting Uk58.

In the Ukiriguru 49 strain trial, NC56 from Namulonge, which had been obtained for testing on the Bukoba/Uganda border, yielded significantly lower than Uk51 (control), 224 lb. lint per acre against 306 lb., or 73% of the Uk51 yield.

In two of the trials on Ukiriguru, in the Lubaga trial and in the district plots trials to be mentioned later, Uk51 from seed continuously grown at Ukiriguru was compared with Uk51 grown from commercial seed stocks from the Bukumbi Ginnery. No obvious deterioration of the commercially grown Uk51 seed, compared with station grown Uk51 seed, could be detected in lint yield, ginning percentage or the other characters measured.

In Table 6 are set out district plot results from four Lake fringe plots. The trials were 16 strain balanced lattice trials, Uk55 and 0/334 each being included twice. Yields for Uk51 (control) varied from around 1,200 lb. seed cotton per acre to over 1,800 lb. The results support the Ukiriguru policy of successive seed issues, with Uk55 now replacing Uk51, and with continued work on segregates from 0/328, 0/334 and 1/667 ex 8/290. 0/95, one of the last surviving representatives of the 5/57 family ex 3/17, has small seed and a high ginning percentage. 0/308, one of the last surviving representatives of the 6/318 family, on which a considerable amount of work has been done on Ukiriguru, can now safely be discarded. 1/686 (ex Barberton U4 × Sea Island) has a low ginning percentage.

TABLE 6.

4 Lake Fringe District Plots—Yield seed cotton lb./acre.						MEAN GINNING PERCENTAGES *(Grade A seed cotton)*	LINT *as percentage mean of Uk51*
DISTRICTS	GEITA *Arugongo*	MWANZA (NASSA) *Shigala*	MUSOMA *Suguti*	UKEREWE (MAINLAND) *Lagata*	MEAN YIELD		
Mz561	1093	976	1057	1710	1209	32·4	85
Uk46	1065	1158	1081	1772	1269	34·0	94
48	1123	1190	1051	1776	1285	34·1	96
51	1196	1223	1208	1928	1389	33·3	100
51 (Bk)*	1220	1101	1271	1807	1348	33·9	
55	1170	1206	1202	2031	1402	34·5	106
55	1204	1374	1160	2049	1447	34·3	108
8/290	1184	1129	1333	1930	1394	33·3	101
0/95	1077	1170	1101	1667	1254	36·4	100
0/308	1057	968	1049	1869	1235	32·4	87
0/328	1317	1166	1172	2057	1428	33·9	105
0/334	1283	1257	1228	2207	1494	34·3	112
0/334	1243	1105	1142	2043	1383	34·1	103
1/667	1245	1210	1107	2094	1414	34·4	106
1/686	1170	1265	1113	1954	1375	32·2	97
2/25	1137	1136	941	1926	1285	34·2	96
S.E.	±44·5	±59·8	±53·9	±85·2			
Sig. Diff. from mean of Uk51 (P = ·05)	110	148	133	210			
Coefficient of Variation	8	11	11	10			
Percentage of Grade C	8	9	16	20			

*Commercial Uk51 seed ex Bukumbi ginnery.

TABLE 7.

DISTRICTS	*7 Inland District Plots—Yield seed cotton lb./acre.*							MEAN YIELD	MEAN GINNING PERCENTAGES (*Grade A seed cotton*)	LINT *as percentage mean of Uk51*
	SHINYANGA		KWIMBA		MASWA					
	Butulwa	*Lagana*	*Mabuki*	*Ilwla*	*Somanda*	*Luguru*	*Lalago*			
Mz561	502	562	643	739	1073	1109	422	721	33·0	73
Uk46	507	616	776	777	1166	1229	614	812	34·2	85
48	604	645	780	684	1191	1146	748	828	34·6	88
51	586	721	800	884	1332	1485	899	958	34·2	100
51 (Bk)*	679	734	907	804	1389	1261	742	930	34·4	
55	679	903	1006	966	1368	1550	992	1066	35·3	116
55	729	857	917	877	1396	1431	1127	1047	35·4	114
8/290	844	724	855	889	1350	1380	845	983	34·4	105
0/95	560	611	770	728	1380	1220	655	846	36·2	95
0/308	436	614	838	672	1234	1297	630	817	33·3	84
0/328	602	713	891	838	1473	1507	1055	1011	35·1	110
0/334	769	804	1129	953	1317	1437	992	1057	35·6	116
0/334	688	849	1034	844	1380	1534	917	1035	35·5	114
1/667	688	717	1127	946	1285	1437	1111	1044	35·5	115
1/686	621	760	960	853	1261	1430	1000	983	33·6	101
2/25	646	705	933	748	1586	1426	826	981	35·1	106
S.E.	±38·3	±36·2	±54·6	±46·9	±75·2	±79·3	±58·7			
Sign. Diff. from mean of Uk51 (P = ·05)	95	89	135	116	186	196	145			
Coefficient of Variation	15	11	14	13	13	13	15			
Percentage Grade C	29	13	16	14	7	15	29			

*Commercial Uk51 seed ex Bukumbi ginnery.

Table 8.

Albar Hybrid Strain Trials and Replicated Progeny Rows.

Trial	Design	Distribution of Lint Yields—% Control (Uk55)																Hybrids outyielding controls significant at P = ·05 (approx.)*	Mean yield of controls lint lb./acre	Coefficient of variation (seed cotton data) %
		60–64·9	65–69·9	70–74·9	75–79·9	80–84·9	85–89·9	90–94·9	95–99·9	100–104·9	105–109·9	110–114·9	115–119·9	120–124·9	125–129·9	130–134·9	135–139·9			
A	5 × 5 balanced lattice (2 controls)					3	4	7	4	5								0	585	11·9
B	5 × 5 balanced lattice (2 controls)				1		6	3	6	1	3	3						1	584	12·9
C	5 × 5 balanced lattice (2 controls)		1	1	4	4	5	2	5	1								0	639	13·4
D	7 × 7 balanced lattice (4 controls)				3	3	5	10	13	5	2	2	2					4	415	11·6
E	7 × 7 balanced lattice square (2 controls)	1		1	1	3	1	6	7	12	4	3	2	4	1	1		2	177	20·9
F	7 × 7 balanced lattice square (4 controls) —replicated progeny rows		1	1	1		2	4	4	9	8	4	4	6			1	9	498	15·7

*All lint yields are calculated from seed cotton yields using ginning percentages determined from duplicate samples of Grade 'A' seed cotton. A difference, significant at approximately the stated probability, is obtained by converting the significant difference calculated for seed cotton, using the mean ginning percentage for all strains in the particular trial.

Details of trials:	A	B	C	D	E	F
Planting dates	4.12.56	4.12.56	4.12.56	22.12.56	6-7.12.56	11.12.56
Plot sizes	5′ × 30′	5′ × 30′	5′ × 30′	5′ × 30′	10′ × 12′ 6″	5′ × 7′ 6″

Spacing (all trials)—2 rows per 5′ ridge at 18″, thinned to 2 plants per hole.

Results from the same strains grown at seven inland district plots are shown in Table 7, Uk55 and 0/334 again being included twice. It was a feature of the season that exceptionally good yields were obtained from the inland districts.

Three insufficiently precise trials have not been included.

For simplicity of presentation, and thus of appreciation, detailed results are shown as yields of seed cotton per acre, with the standard errors and significant differences calculated on seed cotton yields. The mean ginning percentages are shown based on Grade A seed cotton, and the lint percentage comparisons, based on the mean of Uk51, are based on the Grade A ginning percentage figures. The percentages of Grade C are given for each trial.

It is very unfortunate that the multiplication of Uk55 on Kome Island, in its second season, has had to be discontinued because of the presence of *Fusarium* wilt. A fresh multiplication has been started in the 1957-58 season near the Bukumbi Ginnery, an area about 7 miles west of Ukiriguru, from Uk55 seed grown on the station itself.

Diseases.

BY

M. H. ARNOLD.

Bacterial Blight (*Xanthomonas malvacearum*).

Hybrids resistant to bacterial blight.—Testing of the wide range of strains produced by selection in Albar 51 hybrid material continued. 161 selections made in 1955 were compared with Uk55 in strain trials on Ukiriguru (Trials A-E) and 45 selections made in 1956 were included in replicated progeny rows (Trial F). The distribution of lint yields is shown in Table 8 from which it will be seen that in many selections yields comparable with that of Uk55 have been achieved, and in a few this has been surpassed. Re-selections from the higher yielding strains will be planted in the coming season whilst a large number of the poorer strains have been discarded.

Lint samples from 31 of the better strains were sent to the Shirley Institute for testing. Most of those sent were derivatives of third backcrosses and in general the reports showed improvement on last year, when strains derived from first and second backcrosses were sent. The fibre characteristics of these strains had shown a tendency for the Albar hybrids to be slightly shorter and coarser than the standard Ukiriguru strains and to give yarns which were in general somewhat weaker (though there were exceptions). In this year's testing the fibre characteristics of the hybrids in the majority of cases compared favourably with Uk55 and several gave stronger yarns. In

Trial B where Uk55 gave a corrected lea count strength product of 1940, six out of the ten hybrids tested gave counts of over 2100 and the yarns of all but one of these were of better appearance than Uk55.

In the coming season a range of Albar hybrids will be tested against the most advanced "Local" strains in station and district variety trials.

Both this season and last season the comparative earliness of many of the Albar hybrids has been noted. Expressing earliness as the proportion of its final yield of seed cotton which a particular strain had yielded by a given picking (chosen to be such that the control, Uk55, had a value of approximately 75%) correlation diagrams for yield and earliness were prepared for all strains in trials B and D. (On this basis, the hybrids ranged from 62% to 92%). Although, in both cases, the diagrams indicated that Uk55 was both higher yielding and later than the mean of all strains represented, there was no apparent overall relationship between earliness and final yield. This inference must be treated for the moment with some reserve owing to the fact that under this season's conditions there was, as a generalisation, only a limited development of the top crop. Picking on Ukiriguru, which can in some seasons extend into September, was largely completed by mid July. Three high yielding Albar hybrids, covering the main range of earliness represented in the material, will be included as sub-treatments in the time of planting trial next season in order to obtain some information on the advantages and disadvantages of this character.

Third backcross progenies from the programme in which BAR 14/38 (B_2B_{gm}) was used as the source of resistance were disappointing. "Off types", typical of those commonly described as occurring in *hirsutum* × *barbadense* hybrids were of frequent occurrence. 46 resistant plants which were also jassid resistant and of good appearance were selected for further backcrossing.

The strain BAR 12/16, having the gene combination B_2B_{gm} on a *hirsutum* background, has recently been obtained from Shambat—for which grateful acknowledgment is made. A few crosses with this will be made next season using the best available 'Local' strains and Albar hybrids.

A large number of plants in both Albar hybrid and BAR 14/38 hybrid material were boll-inoculated using the technique developed by Logan. Fifty single plants, which appeared to be resistant, were selfed and their progenies will be studied in the coming season.

Resistance in strains of local origin.—The work begun last season was extended and a wide range of strains was tested for resistance. The results, which have been written up in detail elsewhere,* showed that selection for high yield in 'Local' stocks has been associated with

*Arnold, M. H. "Resistance to bacterial blight (*Xanthomonas malvacearum*) in Lake Province 'Local' cotton." Paper presented to the West African Cotton Research Conference, Samaru, Northern Nigeria, Nov. 1957.

TABLE 9.

STEM INOCULATION TRIAL.

Strain	*% Distribution of lesion grades*						*Resistant plants (Grade 0+1)*		*Mean grade*
	0	1	2	3	4	5	%	log (x+2)	
Local	2·6	8·9	45·5	35·1	7·3	0·5	11·5	1·103	2·39
Mz561	3·6	19·5	47·9	28·4	0·6	—	23·1	1·396	2·02
Uk46	2·7	7·5	39·8	39·2	10·2	0·5	10·2	1·011	2·48
Uk48	5·3	14·8	54·0	25·9	—	—	20·1	1·326	2·01
Uk51	7·4	16·6	47·2	25·2	3·7	—	24·0	1·341	2·00
Uk55	32·5	31·9	33·1	2·5	—	—	64·4	1·820	1·03
Albar 49	50·0	47·2	2·8	—	—	—	97·2	1·997	0·51
S.E.								±0·095	±0·12
Sign. Diff. (P=·05)								0·276	0·35

Details of Trial:—Randomized blocks—3 replications. Plot size:—5′×30′.
Average number of plants per plot:— 58. Planted:—15.1.57.
Inoculated:—13.3.57. Scored:—7-9.5.57.

increases in resistance to bacterial blight. An extract of the results for stem inoculation is shown in Table 9 which illustrates the advantage of Uk55 in stem resistance over previous seed issues.

Seed treatment.—Testing of various new copper and mercurial formulations continued. In addition, large scale tests were carried out in one of the Booth Drums.

Whilst cotyledon lesion scores have consistently demonstrated the superiority of mercurial over copper dressings at the same rate of application, the results of one trial showed that Perecot applied, by shaking in tins, at rates of 1:100 and 1:200 parts by weight was comparable with Agrosan GN5 applied at 1:300. Details are shown in Table 10.

In view of these results a recommendation was made that the rate for seed treatment with Perecot in the Province at large be increased from 8 to 9 lb. per ton (giving a rate of approximately 1:250). This policy will be further reviewed early in the coming season when the results of additional seedling scores become available.

TABLE 10.
RATE OF APPLICATION OF PERECOT.
Scores of cotyledon lesions at 28 days after planting.

Treatment		*% Infected*	*Range*	*% Vascular infection*	*Range*
Agrosan GN5	1:300 w/w	4·6	0-10·8	1·0	0- 2·5
Perecot	1:100 w/w	3·5	1·5-6·0	1·3	0- 2·3
	1:200 w/w	4·9	1·9-9·2	1·2	0- 2·1
	1:300 w/w	13·6	5·6-17·6	5·3	0- 9·2
	1:400 w/w	17·4	12·3-28·4	6·8	1·1-18·2

Details of trial:—Randomized blocks with 6 replications.
Spacing—2 rows per 5′ ridge at 18″ in the row.
Plot size—5′ × 25′.
Average number of seedlings scored per treatment = 531.

Two yield trials, similar in design to last year's trial, were laid down—one on rotated land (A) and the other on non-rotated land (B). Trial B was adversely affected by drought at the time of emergence and as a result stands were bad and serious bacterial blight did not develop. In Trial A, 90·8% of the seedlings in the untreated plots showed cotyledon infection compared with 17·5% for Perecot treatment and 2·8% for treatment with Agrosan GN5 (both applied at 1:300 parts by weight). In spite of these big differences in the incidence of primary infection, related yield differences were not recorded, the yields being 914 lb./acre for untreated, 893 lb./acre for Perecot treatment and 900 lb./acre for treatment with Agrosan GN5—all measured as seed cotton (Coefficient of Variation—14%).

Both these trials (and last season's trial) were planted with Uk51. In previous trials, when substantial increases in yield associated with

seed treatment were recorded, Uk46 was used, and it can be seen from Table 9 that Uk46 is more susceptible than Uk51. Although other factors, particularly climatic factors, must also be involved, it seems possible that the degree of resistance in Uk51, even though comparatively small, may have played a part in preventing the heavy primary attack recorded in Trial A this year (and in the one trial last year) from causing heavy reduction in crop.

The design of these trials largely precludes the possibility of measuring the effect of seed treatment on the build up of secondary infection, since there is almost certainly spread of infection from untreated to treated plots during the growing season. Next season an attempt will be made to study this problem using a trial layout which has been successfully employed by Wickens at Namulonge, in which a resistant variety is used as a yield indicator on treated and untreated sites, which are widely separated.

Wilt (*Fusarium oxysporum f. vasinfectum*).

As a result of a survey carried out by officers of the Department of Agriculture, *Fusarium* wilt was discovered in several new localities, including three localities on Kome Island where Uk55 was being multiplied. In view of the possible risk of spread of the disease by seed-borne infection, seed from the whole area was withdrawn from the multiplication programme.

All confirmed outbreaks of the disease, other than those on Kome Island, were confined to the coastal belt in Geita district.

Plants showing symptoms of vascular wilt were again found at Lubaga, but attempts to detect the presence of a wilt fungus failed.

A. G. Whitehead of E.A.A.F.R.O. visited an infested area in Geita district during April in order to investigate the possibility of nematode attack being associated with the disease. He also visited Lubaga. Whilst he was unable to detect the presence of significant nematode populations in the one locality he visited in Geita district, at Lubaga he discovered root-lesion nematodes (*Pratylenchus*) and spiral nematodes which he provisionally identified as belonging to the genera *Rotylenchus* and *Rotylenchulus*.

Subsequently nematodes were discovered in root swellings on infected plants from Kome Island, but these have not yet been identified.

Pests.

BY

J. E. PEAT.

With the stationing of I. A. D. Robertson, Entomologist, at Ukiriguru for work on cotton pests, particularly work on the biology

of American bollworm, exact assessments of populations and the degree of damage they cause will become available for the future.

American bollworm.—On Ukiriguru the Botanist reported a big American bollworm population on the bagged heads of the early planted, early maturing sorghum strains in his nursery, but this population did not give rise to the expected heavy attack later on cotton. A second sorghum planting (early February) collected another very heavy American bollworm population in April-May. Throughout the season on Ukiriguru the American bollworm damage to cotton was local, and largely confined to late planted cotton.

The general district attack was considerably less than in the previous season. There was heavy loss in areas of richer soil, where there was a maize/cotton association; in adjoining areas, for example on the hill soils adjacent to rich alluvial valleys, where there was a bulrush millet/cotton association, American bollworm damage was negligible.

Spiny bollworm.—Steady loss was caused by spiny bollworm, for example in the Musoma district. It is probably associated with areas where there is a considerable amount of wild *Hibiscus.* It has not been possible in the past to assess the extent of the damage caused by spiny bollworm, compared with the more spectacular American bollworm loss.

Stainers.—It was not a bad stainer year, except in marginal areas such as North Mara and Biharamulo. One factor possibly influencing the extent of stainer damage was that, as a generalization, there was little late top crop.

Helopeltis.—This pest was locally severe in Geita district and in a few areas in Musoma district. It was severe in the experimental cotton growing plots near Bukoba. Where it did occur, damage was crippling.

Insecticides.—A start has been made with insecticide testing against American bollworm and stainers. The results, where pest attack was heavy, promise to be in line with the Eastern Province findings.

APPENDIX.

ORIGIN AND SPECIAL CHARACTERISTICS OF THE MAIN COTTON STRAINS MENTIONED.

Lake Province Local	The commercial cotton in the Province prior to the issue of Mz561.
Mz561	A straight selection from Local, first multiplied in the 1939-40 season.

Uk46	A seed issue with fair jassid resistance, made up of the best four Ukiriguru strains and the best three Lubaga strains available at the time, first multiplied in the 1946-47 season.
Uk48	A seed issue made up of four strains of better jassid resistance than Uk46, first multiplied in the 1948-49 season.
Uk51	A seed issue made up of seven strains with jassid resistance, first multiplied in the 1951-52 season.
Uk55	A seed issue made up of 0/334 and 1/667, both ex 8/290, first multiplied in the 1955-56 season.
8/290	Ex 6/320, one of the heaviest cropping Ukiriguru strains, ex 4/35.
0/95	Ex 5/57 ex 3/17.
0/308	Ex 6/318 ex 4/35.
0/328, 0/334, 1/667	Ex 8/290.
1/686	Ex Barberton U4 × Sea Island.
Albar	Nigerian Allen (A1) blackarm resistance (bar) selections made at Namulonge. Two series of selections were made independently, Albar 49 in 1949, and Albar 51 in 1951.
BAR 14/38	B_2B_{cm} Sakel ex Shambat.

Received February 1958.

Printed by T. Buncle & Co. Ltd., Arbroath.